

High-Reliability Microcircuit Procurement Program in the DSN

E. F. Zundel

DSN Data Systems Development Section

A description of the high-reliability microcircuit procurement program is discussed, together with the status and accomplishments in cost reduction and detection of problems which would otherwise go unrecognized. Planned changes and program effectiveness are also discussed.

I. Program Description

The DSN Data Systems Development Section has implemented a program for the procurement of microcircuits screened to a reliability level consistent with the needs of the DSN. Specifications have been prepared which place emphasis on selected process controls to minimize the most frequent industry failure mechanisms, and also to give JPL sufficient visibility into manufacturing operations to insure compliance with JPL requirements.

The program also provides for the establishment of a standard set of logic device types and for constraints which limit designers to their use except in extraordinary justifiable cases. This affords the advantages of:

- (1) A logistical simplification of supply and spares.
- (2) Quantity buys at reduced unit prices.
- (3) Creation of a modest inventory which can adequately support design changes, or management

changes without the penalty of unfavorable procurements to cover the changes.

II. Program Status

Approximately 70,000 devices have been received under this program. Approximately 60,000 are now in production and will be received by October 1975, and additional procurements are planned. Of the total received to date, approximately half (39,000) have been installed in systems.

III. Program Accomplishments

A. Unit Cost

The average unit cost per device has been reduced from \$7.00 on the first procurement to \$3.00 on the current order. There are two major reasons for this reduction in costs: the pooling of orders has resulted in significant quantity discounts, and the test procedures have been

modified in cooperation with the manufacturer. This modification has reduced costs and shortened delivery time with no apparent reduction in reliability.

B. Identified Problem Areas and Corrections

The following problem areas were identified solely because of the JPL specification and the visibility it provides into the manufacturing process. Had the devices been purchased as commercial products or even as supplier-processed MIL-STD parts, the problems would have gone undetected.

1. Foreign material on die (detected at Pre-Cap Visual). This consisted of opaque material on the surface of the die. The supplier's contention that it was on the glass passivation surface only and therefore could do no damage was proved questionable when it was observed also in pre-assembly operations. The supplier agreed to remove all devices that exhibited this condition, until a better understanding of its origin and consequences could be obtained.

2. Lead bonding irregularities (detected at Pre-Cap Visual). Excessive rebond attempts are not permitted by the JPL specification. Since the supplier's requirement was less stringent, many rejects began to appear. A discussion of the condition led to the discovery that the lead frame had been coated with an oily substance which made bonding more difficult. This resulted in a new cleaning procedure to remove the residue.

3. Burn-in deficiencies. Procedures issued by the supplier were not followed completely, permitting devices to be placed in the temperature oven with no electrical stress applied. In another instance, a subcontractor of burn-in services failed to provide required monitoring procedures. In each case, corrective action was taken to insure that all devices would receive full stress for the full time period.

4. Electrical test deficiencies. JPL specifications require 100% testing of each device with variables data furnished. A study of the data revealed the following discrepancies on many occasions:

Discrepancy	Corrective action
Tester malfunction	Retest entire lot
Failed units not removed from test lot	Review each data entry and remove failures
Devices tested twice while next serial number not at all	Review each data entry and remove all suspected failures
Data/device identity lost at post-burn-in tests	Review each data entry and remove all suspected failures or re-test lot

IV. Program Changes

A study of the data submitted with each shipment is being made and, where desirable, the JPL specification limits will be adjusted to agree with the normal data distribution.

V. Program Effectiveness

The objective to provide a procurement program for microcircuits that is cost effective and yields a reliable product has been realized. Of the 39,000 devices withdrawn for system use, only three failures that were not induced are known. One of the three has been verified as a failure, while the other two are under investigation.

Generally speaking, the supplier devotes attention to process details in direct proportion to the interest and concern shown by the customer. The program will continue to be effective as the supplier comes to know that he will be required to demonstrate his compliance with the specifications.